A LEVEL ENVIRONMENTAL MANAGEMENT

The environment is the surroundings and this includes the land, water and the air and this environment must be looked after through environmental management.

Environmental management is the process by which environmental health is regulated by taking steps and behaviours that have a positive effect on the environment, it involves the wise use of resources to have positive impact on the world.

- Environmental management involves the management of all components of the bio-physical environment, both living (biotic) and non-living (Abiotic).
- The environment also involves the relationships of the human environment, such as the social, cultural and economic environment with the bio-physical environment. The resources must be used wisely by the present generation and properly managed so that they benefit future generations(sustainable use)
- Management is achieved through the implementation of environmental policies. An environmental management policy is a set of laws, restrictions, or standards designed to protect and conserve environmental resources meaning that government, individuals and institutions are important players in environmental management. The policies are put in place to regulate pollution and prevent environmental degradation.
- Environmental degradation is the destruction of the natural beauty and value of natural resources resulting in a decrease in quality and value of the resources.
- Environment is the air, water and land as well as their relationship with human beings.
- The three aspects of the environment are the land, water and air.
- **Air**
- Refers to the Earth’s atmosphere. The atmosphere protects life on Earth by providing oxygen, absorbing solar radiation, warming the surface of the Earth and reducing temperature extremes. It contains nitrogen, oxygen, carbon dioxide, other gases and water vapour. Air is important because we cannot breathe and therefore live, without it.
- **Land**
- Is the solid surface of the Earth that is not covered by water. It is important because it provides us with places to live, with fertile soils to grow food, habitat for the Earth’s animals and so on.
- **Water**

- Covers 71% of the Earth's surface. In terms of water as an aspect of the environment, the definition includes ice and water vapour. It also occurs in snow, clouds, rain, fog, and so on. Safe drinking water is crucial to humans and animals. It is important for agriculture and also provide a habitat for many plant and animals species.

Causes of environmental degradation

These can be natural or human induced.

Natural causes

- **Earthquakes** these cause shaking of the earth's crust and in the process the rubble produced and the displacement of part of the earth's crust causes the deterioration of the physical landscape and also the gases which ere usually emitted from broken gas pipes and the resultant fires cause a lot of pollution of the environment for example in 2011 the earthquake which hit Japan.
- **Tsunamis** associated with Submarine earthquakes is also another cause of environmental degradation in the sense that it brings salty water to the land which renders agricultural soils useless and contaminates all sources of drinking water and also causes the destruction of roads, buildings, death of animals and people which in turn result in diseases for example the 2004 Tsunami which affected South East Asia and Indonesia killing 200 000 or more people.
- **Heavy rainfall** is also another physical cause of water and land degradation because it results in wide spread flooding for example recently in Zimbabwe the Tokwe Mukhosi incident in which hundred families were evacuated and the perennial floods of the low lying Muzarabani area were bad lands have been created due to soil erosion.
- **Natural fires** are also a cause of degradation. Such fires are initiated by lightning especially after a long dry spell or during the onset of the rains in areas such as the central parts of Zimbabwe and the Eastern highlands. In 2008-2009 vast tracks of exotic forests were destroyed by fires and the result was severe air pollution and land pollution due to charcoal and ash which remained in the area.
- **Tropical cyclones**, these are natural events which are responsible for widespread degradation of the environment since they are associated with heavy rainfall and very strong winds. For example cyclone Eline which affected Zimbabwe in 2000 left behind widespread degradation in the form of soil erosion and this resulted in heavy accumulations of sands and silts in residential areas and garbage which took weeks to clear.
- **Volcanic eruptions** also are naturally occurring events which cause a lot of degradation in the form of volcanic ash and lahars. For example in the Philippines Mount Pinatubo erupted ejecting a cloud of ash 30 km into the atmosphere and this eruption was followed by a

decrease in temperatures on a global scale. The ash and hot molten magma also does the burning of everything along its path as happened in Indonesia where the deposit of ash was more than 20 cm thick covering a radius of 50 km.

Human factors that result in environmental degradation

- Several industrial plants are powered by fossil fuels such as coal, gas, oil and the use of such fuels result in the discharge of gaseous and liquid pollutants for example industrial processes result in the production of thick black smoke and without a proper filtering system lead to an increase of carbon dioxide emission . Emission of CFCs (chlorofluorocarbon) in atmosphere will through a free radical reaction alter the structure of the ozone molecule (O_3) by breaking the bond to produce free radicals and this breaking down can result in global warming. CFCs can be found in refrigerant products like refrigerator, aerosol spray. Production of nitric acid (HNO_3) through Ostwald process involves a series of combustion releasing acidic gases such as nitrogen dioxide which results in the development of acid rain when the gases combine with rainwater and the net effect is washing out of mineral elements from the soil leaving behind toxic elements which result in the destruction of vegetation and the death of aquatic animals
- In countries like he USA and Japan **auto manufacturing** emits about 1180 tons of organics; 54 tons of N O_x (oxides of nitrogen); 730 pounds of SO_2; and 7 tons of carbon monoxide (CO) . The increase in production of vehicles has led to the increase of usage organic products, and heavy metals which usually pollutes the soil.
- In Kwekwe Zimbabwe the **fertilizers plant at Sable Chemical industries produces** corrosive products like sulphuric acid (H_2SO_4) by Contact process and hydrochloric acid (HCl) , which increase the acidity of water vapour in the atmosphere. Over production of ammonia (NH_3) for fertilizer production, which are not contained in a proper manner increase alkalinity of atmosphere.
- **Building demolition** produces rubble and debris which float and settle in the atmosphere, causing haze and smog .
- **Motor vehicle exhaust** combustion of fuel leads to the production of oxides of lead , nitrogen and sulphur which cause acid rain upon dissolving in water and the degradation explained under industrial processes. Particulates release will cause haze and smog resulting in the poor vision in the area.
- **Heat and power generation facilities** emit excess heat to the atmosphere causing warming of the atmosphere. Thermal power stations discharge hot water back into the rivers and this water can 10-15 times hotter than the water in the river and this has a net effect

of reducing the oxygen carrying capacity of the water causing the death of aquatic animals.

- **Solid waste disposal** -Waste biomass not properly incinerated, incomplete combustion and un recycled remaining waste leads to the release of carbon monoxide (CO), and methane (CH_4. accumulation of waste leads to production of strong odour and humidity, right conditions for pests (houseflies) and bacteria growths which further aggravates the odour in the area. Radioactive and hazardous waste not disposed in enclose area will cause the release of radioactive vapours or substances into atmosphere
- **Fuel production-**. Fuel extraction, processing, refining and distribution add an additional 14% of carbon dioxide emissions (CO_2) fuelling global warming in the process.
- **Electrical components manufacturing-** process of making semiconductors involves the usage of hazardous heavy metal (i.e. arsenic and lead) and the emission of toxic by products into rivers and the atmosphere (i.e. sulphates, nitrates and sulphides)
- **Extraction of metals-** extraction of pure metals involves the heating of coke (carbon); (i.e. iron and silicon) produce carbon dioxide and carbon monoxide these gases contribute towards global warming.

Agriculture also contributes towards the degradation of the environment

- **Synthetic Agricultural Chemicals such as** Pesticides , Herbicides, Insecticides, Fungicides and their accumulation in plants and animals causes the plants and the animals to die, Some of these chemical are non biodegradable which means that they will spread to water sources during rainfall, increasing toxicity of water source killing aquatic life in the process.

- **Chemical fertilizers**, Sewage sludge ,Animal waste, Stimulate algae growth and during decomposition of algae it consumes oxygen which dissolves in the water, decreasing the level of oxygen in aquatic ecosystem and increase the mortality rate (death rate) of flora and fauna. At the same time, decaying material will turn the water murky. This is called eutrophication

- Soil erosion and soil particulates washed by storms and floodwaters from croplands, unprotected soils, will reduce the clarity of the water.

These notes are used to answer the following examination question.

With reference to examples you have studied, outline the main factors that have contributed to and the effects of degradation in urban environments.[16]

Causes of environmental degradation in urban areas

- **Urban traffic** releases exhaust fumes which contribute towards the development of smog which **r**educes visibility in these areas**.**

- **Industries use fossil fuels** which release carbon monoxide and carbon dioxide which contribute towards the development of urban heat islands.

- They also release industrial effluent which contains toxic substances such as arsenic which causes death of aquatic life.

- **Frequent sewage bursts** results in bad smell everywhere and an increase in the amount of houseflies.

- **Deforestation** caused mainly by the fact that in our country these days there frequent power cuts so people will cut any available tree to use as fuel.

- **Dumping of garbage** at undesignated sites is also another form of degradation in urban areas as the city council is neglecting its duty of collecting refuse so people will just dump the refuse creating an eye sore in urban areas. This also increases the amount of houseflies and this compromises the health of urban dwellers.

- **Exhaust fumes** from urban traffic

- **Industrial effluent** These are released in streams and rivers that pass through urban areas causing the death of aquatic animals such as fish.

- Littering in public places such as shops and parks.

- Dust and smoke from brick moulding

- Acid rain due to gases such as sulphur dioxide oxides of nitrogen and carbon dioxide.

- Un collected garbage

In areas such as St Mary’s in Chitungwiza brick moulding has become a source of income and this results in the creation of pits and smoke which degrades the land and cause pollution of the air causing smog.

Effects of environmental degradation in urban areas.

- Pollution of the air, land, water
- The creation of urban heat islands
- Air pollution in the form of litter ,bad smelly water resulting in the development of photo chemical smog reducing visibility
- Different diseases such as cancer, bronchitis
- Decaying of buildings due to chemical corrosion especially those made from limestone rock.
- Eutrophication
- Increased number of rodents such as rats
- Increased incidences of water borne diseases such as cholera as was the case in Harare recently.
- Refuse heaps on undesignated places and litter
- Noise pollution from vehicles, planes and trains
- Site pollution, graffiti on walls
- Scrap metal heaps
- Bare ground due to deforestation caused by the fact that there are frequent power cuts so people cut down trees for fuel.
- Dilapidated buildings/derelict buildings
- Water weeds (hyacinth)
- Murky/dirty/muddy water
- Tree stumps as evidence of the cutting down of trees.

Assess the attempts that have been made to reduce urban degradation

- Legislation e.g. in Zimbabwe EMA. There are also polluter permits which are issued by govt in this case the polluter pays, carbon tax has also been introduced which is compulsory for motorist in Zimbabwe.

- The clean air act has been put in place by the USA Federal govt to try and reduce air pollution.

- Clean up campaigns have been conducted in urban areas for example in Harare recently Minister Amos Midzi carried out a cleanup campaign in his constituency.

- ISO certification, companies become signatories to this United Nations organization and they abide by the standards set by this organ. Difficult to implement in Small and medium enterprises.

- In counties like china they have what they call **park and ride system** where cars have to be parked away from work places in garages and then the owners ride to work and this has been very successful in reducing pollution in urban areas.

- In some countries like UK and Germany they have **banned the use of leaded fuel** so they use unleaded fuel which burns efficiently reducing emissions of carbon monoxide however such fuel is expensive both to the producer and to the consumer. Has been very successful in MEDCs

- **Use of catalytic converters** installed in automobiles and various types of filters and scrubbers in industrial plants exhaust gas transferred through small beads coated with metal that promote reactions neutralizing hazardous gases to harmless ones. Expensive and also requires expertise.
- **Regular collection of refuseand garbage** done by municipal authorities in cities such as Bulawayo, Kwekwe and Mutare. Sometimes the efforts are hampered by frequent truck breakdowns.
- **Educational campaigns** through the press and the electronic media and most products which are likely to cause pollution have tags which advise people to keep their country clean.
- **Burning of litter** done by private companies contracted by the city authorities but this however causes another form of pollution that is air pollution.
- **Smoke precipitation** which involves the spraying of chemicals in the air to disperse smoke. Requires expertise

- **Car pooling**
  Sharing of vehicles between individuals for transportation to work, as adopted by Malaysian Government to reduce vehicle traffic on road and also reduce the emission of exhaust gases (i.e. carbon monoxide (CO), carbon dioxide (CO_2), oxides of nitrogen (NO_x), lead (Pb) and sulphur dioxide (SO_2). Difficult to implement since people in LEDCs are selfish.

- **Public transport**
  Promote the use of public transport for example underground rail or monorail which is fast, efficient and environmental friendly, produce minimal emissions of greenhouse gases. Only applicable to MEDCs.

- **Maintenance of Machineries and Vehicles**regular checkups and replacements of parts to ensure smooth and efficient use of the machineries and transportation ensure the performance of machineries and transportation to meet the standard requirement, so as minimize the production of hazardous materials to be emitted to the environment e.g. in Japan cars are on the road for 3 years and thereafter there are removed and sent for recycling. Difficult to implement in LEDCs.

- **Use of sound absorbers-** expensive and requires expertise

- **The use of very tall chimneys-** chimneys around 5 metres tall

- Repair and replacement of sewer pipes in Bulawayo's Magwegwe suburb.

- Legislation-laws have been put in place such as the clean air act, Isoi certification where companies have to abide by the international standard organization guidelines.

Discuss the view that in some countries, upgrading the environment has proved to be difficult if not impossible

Problems likely to be encountered

- Lack of legislation

- Lack of capital to invest in innovations

- Lack of technology

- Resistance from industrialists

- Lack of alternative options for the existing fossil fuels

- High cost of developing alternative sources of energy

- Fear of loss of employment if coal mines are closed and also the closure of the mines causes industrial decline.

- Hooligans vandalizing public utilities such as street lighting sign posts and also filling walls with graffiti.

- Acid rain continues to corrode buildings

- Vehicle use has remained too high and the use of catalytic converters has proved to be very expensive

Briefly describe the various ways by which rural environments deteriorate in quality [6]

Causes of rural degradation

- Poor land management practices such as ploughing down slope, stream bank cultivation, result in the siltation of rivers thereby increasing the risk of flooding.

- Flood irrigation resulting in severe leaching and salinisation of the soil due to excessive evaporation.

- Monoculture which result in the exhaustion of soil fertility increasing the rate of erosion recently resettled farmers have embarked on a massive deforestation exercise in an attempt to clear land for agriculture and this has resulted in severe and extensive gully and sheet erosion removing the top soil and in the process lowering the agricultural potential of the soil through the removal of nutrients

- Overgrazing caused by overstocking leaves the soil bare and the end result is the reduction in the carrying capacity of the land.

- Over dependence on wood as a fuel and building material causing deforestation which has resulted in severe gully erosion.

- Over use of fertilisers in rural areas which practice semi-subsistence farming such as Zwimba communal lands has resulted in the Eutrophication of rivers for example the River Hunyani.

- Wide spread use of veld fires for hunting especially in the Hurungwe communal lands has resulted in severe soil erosion and the carbon dioxide produced has on a local scale increased the average temperatures.

- Frequent droughts have caused the death of plants and animals leaving the soil exposed to agents of erosion such as wind and running water.

- Poor mining methods such as uncontrolled panning which result in soil erosion and siltation of rivers.

- Unemployment and out migration of the economically active results in a general shortage of labour resulting in economic stagnation and decline

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Assess the attempts that have been made to reduce rural environmental degradation with examples

- **Use of alternative sources of energy** – the rural electrification programme done by the Government and ZESA has seen many rural areas using electricity for lighting and cooking instead of wood however hydro electricity is too expensive and can only be afforded by those who have their relatives working in urban areas. People in rural areas are also buying solar panels especially the people of Tsholotsho and Plumtree since these have a lot of their relatives working in South Africa. This has reduced the use of wood in these areas while in other areas such as Hurungwe(Katenhe area) the tariffs charged by ZESA have proved to be very expensive for the local people and these have resorted back to the use of wood fuel making the attempt fruitless.

- **Paddocking-**this has been conducted in many rural areas including Chitete in Mashonaland West province and has to a greater extent reduced the problem of over grazing. Measures such as destocking have met resistance from the communal people since having many cattle is a sign of wealth according to our culture.

- In the eastern highlands where the land is characterised by steep slopes **terracing** has been done.

- Afforestation and reforestation exercises have been carried out for example in the Chinhamora areas around Tsatse primary and secondary school several wood lots have been created and people are now selectively cutting down the trees for roofing since the houses are now made of bricks and stone. In Zimbabwe on a National scale the first Saturday of December has been set aside for tree planting and this has gone a long way in replacing the cut down trees. Even the president has planted more than 25 trees in the country.

- Resettlement – this has been carried out by Government to reduce population pressure in some rural areas such as Gutu where people were moved to farms in Odzi.

- Food for work programmes have been implemented in rural areas and people have managed to fill gullies through the programme although the youths are unwilling to take part in such programmes.

- Gully reclamation has been a great success in Musana communal areas of Zimbabwe.

Discuss the view that in some countries, upgrading rural environments has proved to be difficult if not impossible [12]

- Farming is the livelihood of people in rural areas and it is done by the poor people so it is difficult to change.

- Poor management of the land contributes towards severe soil erosion

- Wood still remains the main source of fuel and building material, it is affordable to the poor so people continue to cut down trees.

- There is a general lack of capital and high levels of corruption by top government officials such as members of parliament who divert funds meant for the exploration and exploitation of other sources of energy.

- Having many cattle is a sign of wealth hence it is becomes very to convince rural to destock.

- Again cows are used to pay debts so in rural areas it is security

- Ineffective education campaigns due to lack of supervision.

- Natural disasters such as drought and flooding contribute towards severe soil erosion. Floods destroy landscapes especially in countries like Mozambique and such a country there is little government assistance so the poor affected find it difficult to cope with the hazard.

The degree of degradation in an area causes some environments to be of high quality while some will be of poor quality.

Describe the characteristics of high and poor quality environments

Characteristics of high quality environments

- Good amenities in terms of housing and health

- State of the art schools, hospitals and recreational facilities

- Pollution free environment

- Clean pavements, streets, public places such as bus stops and toilets
- Smooth roads and good working street lights and robots.
- High biodiversity with green sites
- High standards of living
- High per capita income
- Good agricultural production which is sustainable.

Characteristics of poor quality environments

- Poor housing and health facilities
- Delapidated educational facilities
- Heavily polluted areas
- Frequent sewage bursts
- Grafitti on walls
- Litter all over public places
- Dirty public toilets
- Gullies and pot holes
- Vandalized street lights and traffic lights out of order
- Generally low living standards
- Low species diversity with severe deforestation.

Differentiate between high and poor quality environments

Characteristics of high quality environments

- Good amenities in terms of housing and health
- State of the art schools, hospitals and recreational facilities
- Pollution free environment

- Clean pavements, streets, public places such as bus stops and toilets
- Smooth roads and good working street lights and robots.
- High biodiversity with green sites
- High standards of living
- High per capita income
- Good agricultural production which is sustainable.

While poor quality environments are characterized by

- Poor housing and health facilities
- Dilapidated educational facilities
- Heavily polluted areas
- Frequent sewage bursts
- Graffiti on walls
- Litter all over public places
- Dirty public toilets
- Gullies and pot holes
- Vandalized street lights and traffic lights out of order
- Generally low living standards
- Low species diversity with severe deforestation.

Air pollution

- This refers to the introduction of gases and particulates into the atmosphere which result in the alteration of the composition of the atmosphere. Such a situation results from the emission of gases/vapours into atmosphere. Some of the gases such as carbon dioxide are greenhouse gases so they end up enhancing the green house effect resulting in Global warming. Some of the particulates such as dust and smoke particles remain suspended in the air

resulting in the development of smog which reduces visibility. Some of these gases result in the emergence of new chemical reactions of reactive and non-biodegradable compounds which result in the depletion of the Ozone layer causing global warming in the process.

Causes of air pollution

- motor vehicle exhaust -combustion of fuel lead to the production of oxides of lead , nitrogen and sulphur , oxides of lead , nitrogen and sulphur dissolve in water vapour and alter its pH causing it more acidic resulting in acid rain. Particulates released in exhaust fumes cause haze and smog resulting in the poor vision in the area

- heat and power generation facilities -emission of excess heat to atmosphere causes warming of the atmosphere .Waste biomass not properly incinerated results in incomplete combustion producing toxic gases such as carbon monoxide and un recycled remaining waste leads to the release of carbon and methane (CH_4) which is a green house gas which contributes towards enhancing the green house effect and global warming.

- Industrial processes –production of thick black smoke emitted without a proper filtering system lead to an increase of carbon dioxide emission. Emission of CFCs (chlorofluorocarbon) in atmosphere will through a free radical reaction alter the structure of the ozone molecule (O_3) by breaking the bond to produce free radicals resulting in warming of global average temperatures.. CFCs can be found in refrigerant products like refrigerator, aerosol spray. Production of nitric acid (HNO_3) through Ostwald process involves a series of combustion and it releases oxides of nitrogen it the atmosphere resulting in acid rain and the death of aquatic animals and vegetation

- Auto manufacturing-emits about 1180 tons of organics; 54 tons of NO_x (oxides of nitrogen); 730 tons of SO_2; and 7 tons of carbon monoxide (CO) and an increase in the production of vehicles has led to the increase of usage of organic products, and heavy metals

- fertilizers plants –emit corrosive byproducts like sulphuric acid (H_2SO_4) by Contact process and hydrochloric acid (HCl) , which increase the acidity of water vapour in the atmosphere and over production of ammonia (NH_3) for fertilizer production, increases the alkalinity of atmosphere

- building demolition -crumbling rubble and debris which floats and settles in the atmosphere, causing haze and smog (i.e. benzene, asbestos, beryllium, inorganic arsenic)

- solid waste disposal -accumulation of waste leads to production of strong odor and humidity, right conditions for pests (houseflies) and bacteria growths which further aggravates the odor in the area. Radioactive and hazardous waste disposed in open spaces will cause the release of radioactive vapors or substances into atmosphere which have harmful effects on human health.

- solvent evaporation -vaporization of complex organic solvents which are non biodegradable (i.e. non methane organic compounds: ethane, ethylene, aldehydes, ketones) results in the green house effect being enhanced causing global warming. Production of strong unpleasant odor (i.e. lubricants, paints)

- Volcanic eruption -toxic and poisonous gases of SO_2, NO_2 and PbS_2 spewed out and heat produced during eruptions will increase the temperature of atmosphere, altering the rate of chemical reactions occurring.

- fuel production - fractional distillation of crude oil to produce kerosene, gasoline and refinery gas by the cracking process adds an additional 14% of carbon dioxide emissions (CO_2)

- roadway construction -manufacture of construction equipment comparable to the degree of pollution of auto manufacturing ,asphalt fumes which are bothersome and toxic, involves the release of both particulate benzene (C_6H_6) – soluble organics and individual aromatic hydrocarbons which pollute the air.

- extraction of metals -extractions of pure metal involves the heating of coke (carbon); (i.e. iron and silicon) produce carbon dioxide and carbon monoxide and these are green house gases.

- forest fire- release of particulates into atmosphere causing smog and haze results in the poor vision of sight in the area. Forest fire also releases carbon dioxide and increases the temperature of the atmosphere through direct heat resulting in an overall increase in global temperatures.

Ways of reducing air pollution

The use of clean sources of energy.

- renewable sources which can be used many times, involves minimal cost and also restricted use of hazardous materials in use, especially in the use of energy
- current clean technologies available:

- hydropower
- solar energy
- wind power
- geothermal energy

Catalytic Converters

- installed in automobiles and various types of filters and scrubbers in industrial plants
- exhaust gas transferred through small beads coated with metal that promote reactions neutralizing hazardous gases to harmless ones

Transportation Alternatives

- Car pooling
  Sharing of vehicles between individuals for transportation to work, as adopted by Malaysian Government to reduce vehicle traffic on road and also reduce the emission of exhaust gases (i.e. carbon monoxide (CO), carbon dioxide (CO_2), oxides of nitrogen (NO_x), lead (Pb) and sulphur dioxide (SO_2)
- **Public transport**
  Promote the use of public transport for example underground rail or monorail which is fast, efficient and environmental friendly, produce minimal emissions of greenhouse gases.
- **Use of un leaded fuel**
- **Use of dust filters** at refineries such as those for minerals such as copper and iron ore.
- **Use of alternative** fuels other than petroleum such as solar and electricity from hydro electric generation plants.
- **Carbon tax**
- ISO certification.

Maintenance of Machineries and Vehicles

- regular checkups and replacements of parts to ensure smooth and efficient use of the machineries and transportation
- Ensure the performance of machineries and transportation to meet the standard requirement, so as not to produce any hazardous material to be emitted to the environment.
- Putting in place laws and regulations which regulate the operation of companies and industries for example in the USA they have the following policies and laws

The National Environmental Policy Act of 1969 (NEPA)

- Encourages productive and enjoyable harmony between man and his environment by promoting efforts which prevent or eliminate damage to the environment and biosphere stimulating the health and welfare of man; It also enriches the understanding of the ecological systems and natural resources important to the Nation.

The Clean Air Act (CAA)

- Is a comprehensive Federal law that regulates air emissions from an area for both stationary, and mobile sources and aims to achieve NAAQS (National Ambient Air Quality Standards authorized by U.S. Environmental Protection Agency)

Awareness and educational campaigns through

- Environmental Physics
- Documentaries
- Field Trips
- Competitions
- Parental Guidance
- Environmental Clubs & Societies
- Environmental-Based Games
- **Protocols and Conventions**
  Implementations and adoption of protocols discussed and exchange ideas and opinions by scientist, environmentalist and leaders worldwide on the measures on preventions, treatments and control, and management on the global environmental state facing every nations for example:

- Montreal Protocol
- Kyoto Protocol
- Basel Convention
- Ozone Secretariat
- Through the use of organisations and non-governmental organisations
- Imposition of fines and penalties for air polluters through the polluter pays principle.
- Introduction of carbon tax

<u>Organizations</u>
governing and non- governmental organizations (NGOs) which are in charge of initiating the plans and objectives of each society to encourage public participations on the sustainable management of environment, and as a medium of communications between the public and government concerning environmental issues

Water pollution

Water pollution is the contamination of water by foreign matter that deteriorates the quality of the water. Water pollution covers pollutions in liquid forms like ocean pollution and river pollution. As the term applies, liquid pollution occurs in the oceans, lakes, streams, rivers, underground water and bays, in short liquid-containing areas. It involves the release of toxic substances, pathogenic germs, substances that require much oxygen to decompose, easy-soluble substances, radioactivity, etc. that become deposited upon the bottom and their accumulations will interfere with the condition of aquatic ecosystems. For example, the eutrophication: lack of oxygen in a water body caused by excessive algae growths because of enrichment of pollutants.

Type of water which is polluted

Sea water, river water, dam water, lake water and underground water

Sources of water pollution

We can classify major sources that lead to water pollution to the following categories:

Petroleum products

- Accidental spills from ships,boats, tanker trucks, pipelines and leaky underground storage tanks
- Old and faulty machineries in industrial factories which are inefficient
- Improper refinery processes with the production of toxic byproducts all being released into the water
- Rain wash from roads.

Synthetic agricultural chemicals

- These include: Pesticides, Herbicides, Insecticides, Fungicides, Some of these are non-biodegradable so they accumulate in animals and plants and when these die the chemicals are released into water sources during rainfall, increasing toxicity of water source.

Heavy metals

- Emission of oxides of lead from tractors and machineries used during mining or in industries which dissolves in water ,Improper storage of heavy metals in storage container

- **Excess organic matter** such, sewage sludge , animal waste stimulate algae growth and during decomposition of algae it consumes oxygen which dissolves in the water, decreasing the level of oxygen in aquatic ecosystem and increase the mortality rate (death rate) of flora and fauna. At the same time, decaying material will turn the water murky. This is called eutrophication
- **Sediment -**Soil erosion and soil particulates washed by storms and floodwaters from croplands, unprotected soils, strip mines, roads and bulldozed urban areas into water sources alters the clarity of water
- **Microbes (virus, bacteria, protozoan) are infectious organisms** because their growth consumes nutrients in lakes, rivers, oceans and Infect plants and animals in the aquatic ecosystem which die .
- **Thermal pollution**- Water drawn from rivers and lakes to be used as coolants in factories and power plants leaves these plants being warmer and when returned to rivers and lakes it alters the species makeup of the aquatic ecosystem, introducing infectious organisms and others which are adaptable to warmer temperature, which alter the water composition in the lake or river. The level of oxygen in water sources will be reduced, threatening the aquatic ecosystem which leads to the death of many species and in turn make the water murky.
- **Volcanic eruptions** release mud and ash which contaminates water sources and also disturbs the clarity of the water affecting processes such as photosynthesis
- **Domestic pollution** from sewage bursts, use of non-biodegradable substances such as detergents.

Attempts to reduce water pollution

- **Bioremediation -**enhance the development of indigenous microorganisms to accelerate biodegradation of organic constituents in saturated zone. This is a slow process which also requires a high degree of expertise.

- **Dispersing Agents-** chemicals that contain surfactants which catabolyze oil into small droplets which disperse into the water column where they are subjected to natural processes from wind, waves and currents that further accelerate breakdown, frequently used at rough or choppy conditions at sea where mechanical containment and cleanup difficult.

- **Sorbents- these are** materials that soak up liquid, which is oleophillic (oil attracting) and hydrophobic (water repellent) and are effective in oil spills, depend on:

    - rate of absorption determined by type of sorbents and the type of oil
    - ease of application determined by type of sorbents and the type of oil

    Types of sorbents

    natural organic: loose particles such as sawdust which can soak up 3 and 15 times their weight of oil with the help of a flotation device to overcome the sinking problem

    - **natural inorganic**: clay, glass wool, sand or volcanic ash which can absorb 4 to 20 times their weight in oil
    - **synthetic**: polyethylene, nylon fibres which can absorb 70 times their weight in oil where some can be cleaned and reuse while some had to be disposed after first use.
- Through replacing and repairing burst sewer pipes
- Treating sewage before discharging the water into rivers
- Educational campaigns on the use of detergents in toilets.

Through the introduction of laws and regulations

For example-

The Clean Water Act (CWA)

- set the basic structure for regulating discharges of pollutants to waters of the United States Authority given to EPA to set effluent standards on an industry basis (technology-based) and continued the requirements to set water quality standards for all contaminants in surface waters

The Oil Pollution Act of 1990 (OPA)

- Streamlines and strengthens EPA's ability to prevent and respond to catastrophic oil spills and requires oil storage facilities and vessels to submit to the Federal government plans detailing how they respond to large discharges. It develops Area Contingency Plans to prepare and plan for oil spill response on a regional scale.

The Pollution Prevention Act (PPA)

- Focuses on industry, government and public attention on reducing the amount of pollution through cost-effective changes in production, operation, and raw materials use. It includes other practices that increase efficiency in the use of energy, water, or other natural

resources, and protect our resource base through conservation. Practices include recycling, source reduction, and sustainable agriculture

- **The Safe Drinking Water Act (SDWA)** which aims to protect the quality of drinking water in the United States. It focuses on all waters actually or potentially designed for drinking use, whether from above ground or underground sources and it establishes safe standards of purity which all owners or operators of public water systems comply with primary (health-related) standards.
- **Treating sewage** before discharging it into rivers, Lack of chemicals can be a problem

Noise Pollution

Refers to the production of sounds at high intensity which causes many disturbances and irritation to people emotionally and has adverse effects on their daily activities. This particular pollution is ever increasing due to the rise in the utilization of heavy duty machineries of industrial facilities and vehicles, synonymous to the increase in the standard of living in most countries.

Sources of noise pollution.

Road traffic noise

- increasing community reliance on road transportation, and a reluctance to accept partial solutions involving greater use of public transport
- poor land use planning allowing residential developments and major transport corridors to occur in close proximity without appropriate buffer zones or treatment to buildings.
- inconsiderate drivers speeding at the same time honking uncontrollably for no apparent reason, which terms this drivers as road bullies.

Air traffic

- military air force training with war planes and fighters flying at inappropriate late hours at low flying altitude in close proximity to residential areas
- increased numbers of commercial flights over the years to accommodate the increasing demand to the number of passengers throughout the world, flight path taken through densely populated area causing disturbances and interfere with the tranquility of the environment

Rail traffic

- construction of rail infrastructure involves drilling and other heavy machineries which emits loud and deafening noises
- maintenance of rail infrastructure needs to be checked and done in order to ensure the safety of the rail involves the replacements of old platforms, trains and foundation using heavy machineries emitting loud noises
- operation of trains increasing everyday, especially during festivities in which it is operational for 24 hours
- use of petrol and diesel engines in poorer countries than the quieter electric train and also older version of rolling stock

Neighborhood and domestic noise

- close proximity of home with each other without a good sound barrier often results in neighbours enduring the noises made outdoors which includes barking dogs repeatedly during night time where the whole neighbourhood is calm
- Lawn mowing, car alarms and other social gathering like weddings and church services using disco machines creates a lot of noise.

Incompatible land use

- improper determination of land zoning where heavy industrial sites are adjacent to residential areas resulting in noise disturbances in the residential area
- frequent changing land uses over many decades have resulted in unacceptable noise

Industrial noises

- heavy machineries mechanisms during combustions produces deafening sounds
- mining and dredging also results in increase noise level involved
- Extractions of pure metals in coke ovens under high pressure make a lot of noise.
- Electrical components manufacturing and fertilizer plants also make deafening noise.

Methods of reducing noise pollution

Insulation

- sound proofing to doors, walls and ceilings to decrease the level of noise in office to prevent

excessive disturbance
- insulator usually employed in theatre and cinemas are curtain to avoid the formation of echo during theatrical performance
- use of ear piece for protection of workers in industrial working areas
- Construction of sound barrier separating urban housing and nearby highway to reduce the noise level produced from heavy traffic vehicles.
- Use of silencers on vehicles
- Shift from diesel trains to the use of electric trains
- Education and skills training
- Impounding of un road worthy vehicles.
- The park and ride principle practiced in countries such as China

Vegetation

- absorption and screening of noise pollution in housing area and cities, adopting the 'green city' concept

Zoning

- restructuring of urban areas to maintain a separation between residential areas and zones of excessive noise
- systematic coordination of development in an industrialized area to ensure proper zoning of factories from buildings nearby
- sustainable development of industries proportion to an area to ensure equilibrium with population in that area in order to produce a balanced physiology and psychology of its inhabitants.

Land Pollution

Land pollution involves the deposition of solid waste and the accumulation of non-biodegradable materials and the introduction of toxic substances into the soil resulting in the alteration of soil chemical composition.

By as much, land pollution of this has amassed globally, everyday threatening the very foundation and mechanical support of every matter on earth. Statistically, it has been shown that:

- loss of 6 million hectares of land per year

- loss of 24 billion tons of topsoil per year
- loss of minimum 15 million acres prime agricultural land to overuse and mismanagement
- desertification of land results in the loss of 16 million per square km of world's land surface

Sources of land pollution

- **Unhealthy soil management methods;**
  - improper tillage of soil in which excessive tillage result in the deterioration of soil structure
  - non-maintenance of a proper supply of organic matter in the soil from the imbalance composition of the reserves of organic matter especially nitrogen, phosphorus and sulphur unplenished supply after cultivation of vegetation, living the soil prone to soil infertility, unable to stabilize the soil physicality which ultimately leads to desertification.
  - irregular maintenance of a proper nutrient supply of trace elements gives rise to the use of excessive synthetic fertilizers, which are non biodegradable and accumulate in the soil system which eventually destroys useful organisms such as bacteria, fungi and other organisms
  - improper maintenance of the correct soil acidity which ultimately disrupt the adaptation of various crops and native vegetation of different soils as the solubility of minerals present will be affected. In a more acidic soil, minerals tend to be more soluble and washed away during rainfall while alkaline soil, minerals are more insoluble which form complex minerals unable to be absorbed into the flora system physiological usage.
- **Improper irrigation practices;**
  - poorly drained soil result in salt deposits leading to high soil salinity that inhibit plant growth and may lead to crop failure
  - un irrigated land giving rise to stagnation of agriculture waste products which accumulate and increase land toxicity
- dumping of garbage and waste at undesignated places creating an eyesore.
- Nuclear waste disposal and weapon testing renders millions of hectares of land useless.
- Mining and quarrying causes deforestation resulting in the creation of bad lands(heaps and pits), it also loosens the soil accelerating the rates of soil erosion.

Ways of reducing land pollution

- Composting
- Incineration of garbage although this causes air pollution.
- Burry nuclear waste deep under the sea
- Clean up campaigns
- Recycling recyclable materials such as plastics and scrap metal and paper

Soil erosion

This ids the removal of the topsoil by the action of running water and by wind at a rate which is faster than the rate at which the soil is being formed.

Signs of erosion

- Exposed roots
- Muddy water in times of rainfall
- Rills and gullies on the surface
- Bare dry ground
- Deep cattle and human tracks
- Deposition of sand and silt along river channels, in gullies and on the earth’s surface.
- Shallow depressions caused by wind
- Sandy and stony surfaces

Causes of soil erosion

These can be classified into natural causes and human induced causes

Natural causes

- Nature of rainfall-high intensity rainfall compacts the soil and reduces the infiltration capacity of the soil resulting in the raindrops detaching soil particles which are later removed by surface runoff.

- Type of soil- this affects the erodibility of the soil for example sandy soils which are dry with very little humus are easily eroded and those soils with a high content of sodium since it readily dissolves in water.

- Steepness of the slope-steep slope promote surface runoff due to increased gravitational pull thereby promoting soil erosion and the accumulation of the water down slope results in severe gully erosion.

- Frequent droughts- these results in reduced vegetation cover which exposes the soil to both wind and water erosion

Soil erosion is also caused by human related activities which include

- Mismanagement of arable land- activities such as over cultivation causes soils to become exhausted resulting in them being loose and easily eroded by both wind and water. Slopewise cultivation creates artificial channels which contributes towards erosion. Stream bank cultivation causes the soil along banks of the channel to become loose and readily eroded by running water.

- Overstocking- causes overgrazing which leaves the soil bare and loose resulting in increased rates of erosion. Running water also deepens cattle tracks to form rills and gullies.

- Mismanagement of forest stands- this results in deforestation which leaves the soil brae encouraging soil erosion by water and wind in the process.

- Mismanagement of wetlands such as vleis/bambos- random digging for river and pit sand results in severe erosion of the soil.

- Gold panning also loosens the soil allowing running water to wash away the top soil

Measures against environmental degradation caused by various farming systems

- Destocking and Paddocking

- Crop rotation

- Shift from artificial fertilisers to the use of organic manure

- Terracing

- Contour ploughing

- Legislation against stream bank cultivation.

Deforestation

Deforestation is the degradation of forest areas in unsustainable rates, caused by human activities.

Causes

Population increase, demands more lands to use for cultivation, residence and commerce areas, added by inappropriate technology.

Impacts

- increases in global greenhouse gases rate (from 1850 - 1990, deforestation contributes to 122 billion metric tons of carbon to the atmosphere)
- reducing the evaporation and evapotranspiration processes in forest, thus decreasing precipitation rates, and makes the surface warmer, consequently lead to atmosphere warming
- declining of biodiversity
- erosion and soil degradation

Desertification

Desertification is the land degradation in dry lands. It's caused mainly by human impacts, causing deterioration to the quality of soil and water sources, causing drastic fall to soil fertility. The final product is desert, making the place almost uninhabitable.

Causes

- Clearance of forests (deforestation), making the soil exposed to erosions
- Drought
- Climate change (to warmer condition), leading to high severity of drought
- Poor resource management in dry
- lands

Impacts

- Infertility of soil
- Degradation of nutrient content of the soil
- Hunger and higher vulnerability of diseases

- Economic and social downturn
- Lost of biodiversity
- Effects to climate change (no trees to process photosynthesis)
- Ultimate low rate of rainfall

Global warming

Global warming is the extraordinary increase of Earth's surface temperature due to the increase of greenhouse gases concentration on the atmosphere which enhance the greenhouse effect. Greenhouse gases are the heat-trapping gases in the atmosphere (carbon dioxide, methane, nitrous oxide, and CFC). They are the fundamental parts of the greenhouse effect. The role played by the atmosphere to continually warm the earth, by trapping some portions of heat that came from the solar energy (sun radiation) from reflecting back to space --- just like the work of a greenhouse.

Causes of Global Warming

- **Rapid use of fossil fuel**
  Rapid use of fossil fuel will emit large amount of greenhouse gases, especially carbon dioxide.
- **Deforestation/clearing of lands**
  The increase of human population coincidentally demands for more lands to use. This leads to clearance of forest area in many regions. By eliminating forests, carbon dioxide that actually should be photosynthesized is left in the atmosphere and accumulate to contribute to the increase.
- **The use of CFC in electronic appliances**
  CFC, or chlorofluorocarbon is a gas that decreases ozone (O_3) in the atmosphere, causing ozone depletion that increase the amount of solar radiation arriving to the Earth. (See ozone depletion)
- **Open burning of trash**
  Open burning of trash worldwide emits greenhouse gases.
- **Vehicle and industrial emissions**
- **Volcanic eruptions**

Signs of Global Warming

- The receding of ice formations on Earth (snows at mountain-tops, glaciers, and Antarctic and Arctic ice)
- The increase of shrubbery in Arctic
- Thinner clouds over the sky, that decrease the ability to reflect heat from the sun (as studied by NASA)

- The discovery of the decrease of Earth's albedo (the amount of sunlight reflection by the Earth surface to the Moon) by 2.5 percent, which means the Earth has loosen some levels of capability to reflect sunlight to the Moon.
- Change in wind directions

Impacts

- Stormy weather (more chances for hurricanes, floods, cyclones, and storms to happen)
- Increased severity for drought, hunger and spread of diseases, especially in poor countries
- Declines of amphibians, caused by altered precipitation patterns resulted in lower levels of pond and lake waters, where amphibians survive.
- Damages to coral reefs
- Marine diseases
- Rising ocean temperature
- Ecosystem degradation
- Declining of biodiversity
- Creation of environmental refugees.
- Economic and social downturn

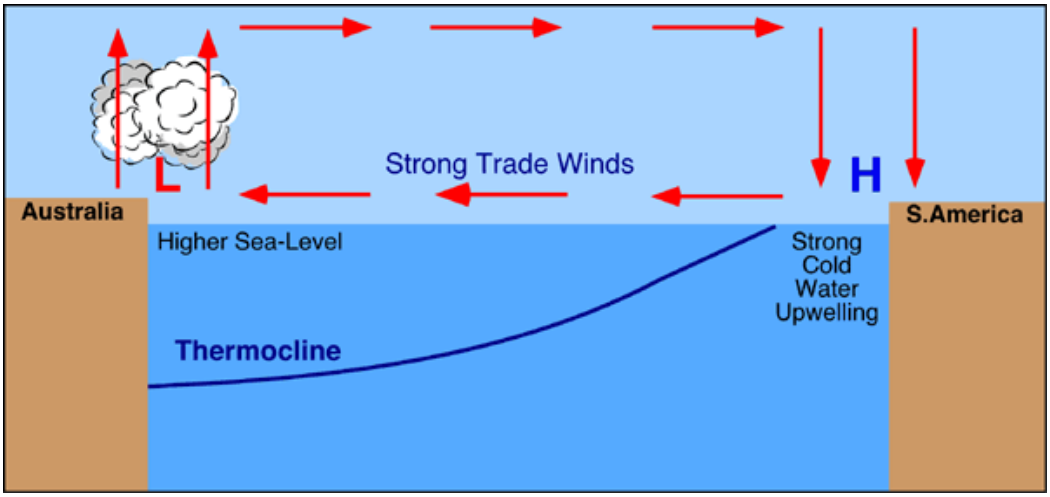
El Nino

El Nino is described as the "*disruption of the ocean-atmosphere system in the tropical Pacific having important consequences for weather around the globe*". This involves the unusual warm conditions that appear in the coastal areas near Peru and Ecuador, South America. Actually El Nino is a term used to describe the warm southward current of the Pacific Ocean, that appears every December of the year. However, it's now become more intense and severe over the past years, especially in the 1982 and 1983 season, and once occurring, it affects the climate for one year around the globe. It's now happening every 3 to 7 years, including 1972, 1976, 1982/1983, 1987, 1991, 1994, 1997.

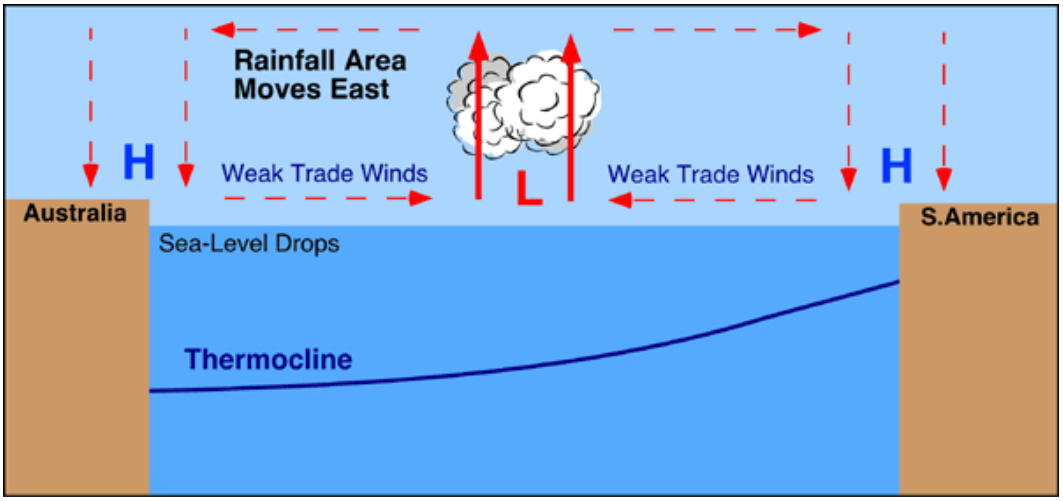
El Nino's disturbance to the weather system is identified by the reversal of the normal weather conditions in the eastern and western Pacific caused by the sufficiently warm and persistent ocean currents. During this event, the trade winds that usually blow from east to west is collapsed and even reversed to blow from west to east, thus changing the climatic pattern of the western Pacific and the eastern Pacific. The western Pacific that usually moist, warm and high in rainfall is changing to an arid and low rainfall condition thus bringing droughts to south-eastern Asia, India, and southern

Africa. While the eastern Pacific that usually arid, cold and low in rainfall is reversed to a moist, warm and high in rainfall, leading to heavy rainfall in the areas See diagrams

Normal circulation in the Pacific



- In an El Nino year, air pressure drops over large areas of the central Pacific and along the coast of South America



- The normal low pressure system is replaced by a weak high in the western Pacific (the southern oscillation).
- This change in pressure pattern causes the trade winds to be reduced.
- This reduction allows the equatorial counter current(which flows west to east - see ***ocean currents map***)to accumulate warm ocean water along the coastlines of Peru and Ecuador

- This accumulation of warm water causes the thermocline to drop in the eastern part of Pacific Ocean which cuts off the upwelling of cold deep ocean water along the coast of Peru.

Impacts

- Climatically, the development of an El Nino brings drought to the western Pacific, increased risk of forest burns. rains to the equatorial coast of South America, and convective storms and hurricanes to the central Pacific.

- Drought in southern Africa

- Warmer winters in the USA.

- Economical effect particularly in coastal areas of Peru and Ecuador. In normal condition the cold water supports large populations of fish, however, during El Nino the coastal areas are warmer, depleting nutrient in the area thus causing lack of food for the fishes.

- Health problems, especially in drought areas.

Ozone depletion

Ozone layer is a protective layer in our atmosphere (O_3, three oxygen atoms). It's about 19 to 30 km in distance from the Earth surface. It plays an important role of blocking ultraviolet (UV) rays that come from the sun, which, if there was no ozone layer ever, cancer would dominate and even no life would be in this world! The concentration of the layer is usually under 10 parts ozone per million. The ozone layer is made up by the action of sunlight to oxygen, and the amount is stabled by the existence of nitrogen.In today's trends there is a noticeable depletion of the ozone layer. It's popularly known since 1970 that a substance called CFC (chlorofluorocarbon) is threatening the layer. This substance is usually contained in refrigerators, coolants, and aerosol sprays. When we use much of those things (which contain CFC), we are continually depleting our Earth's ozone layer. However, most of the latest products today do not contain CFC anymore. Some other substances, like bromine halocarbons and nitrous oxides are also possible threats.

The effects of ozone layer depletion are:More ultraviolet rays come to Earth (this could make the Earth just like a cooking oven) . More heat, thus increasing the risk of global warming

How CFC depletes the ozone layer?

1. CFC molecule, consisting of one atom for each fluorine and carbon and 3 chlorine atoms, is hit by the UV rays.
2. One chlorine atom breaks apart. It will hit an ozone (O_3) and takes one oxygen atom away to create chlorine monoxide, thus leaving one oxygen molecule (O_2).
3. Another oxygen atom breaks the chlorine monoxide and takes the oxygen atom away, leaving one chlorine atom, leaving no ozone molecule. Process repeats.

Acid rain

Acid rain is the kind of precipitation that contains larger amounts of acid than normal. Rainwater is usually slightly acidic, with pH level between 5 and 6. Water that evaporates from earth is neutral (pH 7) and it becomes weak acid when mixed with carbon dioxide in the atmosphere. Acid rain contains more pH than ordinary. This is caused by the presence of air pollutants, like sulphur dioxide and nitrogen oxides. They produce acids if combined with water. Acid rain is considered as the wet deposits of air pollutants, where it's combined with moisture before falling into the ground. While air pollutants that fall without combining with moisture is called dry deposits.

Acid rain can occur naturally, from the volcanic eruptions. However we are also causing this, from the emission of vehicles and of industrial plants that include the burning of fossil fuels. If we continue to increase rate of air pollution, we are increasing the risk of acid rain to happen.

Impact of acid rain

- Deteriorates building that is made of rock
- Acidification of soil and lakes resulting in the death of aquatic animals.
- Separation of poisonous minerals such as aluminium and mercury from the surrounding ground, increasing the risk of contamination to lakes/water sources
- Deteriorates trees and forest